FLUSHLESS MOLD VALVE ASSEMBLY

BACKGROUND OF THE INVENTION

[1] The present invention relates to a low-pressure mold assembly, and more particularly to a valve assembly for a mold which minimizes the frequency of flushing.

[2] A low pressure molding system provides for the mixing of at least two fluid materials to form a settable mixture which is discharged into a mold cavity to form a finished article. One particular mixture includes three fluid material components which form a matrix having a catalyst, a matrix polymer and a foaming agent. The fluid materials are typically fed from a supply by a delivery or feed assembly which communicates with a mixing head. The fluid materials are mixed by the mixing head and discharged into the mold cavity to form the molded article.

[3] Typically, the mold valve and mix head must be flushed after each cycle to remove remnants of the fluid material components to prevent the remnants from hardening within. This is time consuming and expensive as the flushing fluid must be disposed of after usage.

[4] Accordingly, it is desirable to provide a valve assembly for a low-pressure mold which requires minimum flushing. It is also desirable to minimize the necessity of flushing the mix head between transfer from one mold assembly to the next to decrease the cycle time for production of each finished article.

SUMMARY OF THE INVENTION

[5] The present invention provides a valve assembly which includes a coupler to removably attach a mix head to a mold assembly in an assembly line environment. The coupler is attached to a mold port such that the matrix is communicated from the mix head s through a fluid flow passage and into the mold cavity.

[6] A piston which is rectilinear in cross section is movable within the first flow passage along a first axis by an actuator. By providing the piston, with straight walls, remnants of the matrix are more effectively wiped from the passage and driven into the mold cavity. In

addition, the piston forms an effective seal at the intersection between the first flow passage and the second flow passage.

[7] The mix head include a secondary portion of the second flow passage which aligns with the second flow passage within the coupler when the mix head is attached thereto. A second piston is movable along a second axis substantially perpendicular to the first axis by a second actuator. A third fluid flow passage communicates with the mix head mix chamber and the second flow passage

[8] During matrix injection, matrix is supplied from a feed system to the mix chamber. From the mix chamber the matrix is feed through the third flow passage and into the mix head second flow passage. The matrix continues into the coupler second flow passage and into the primary flow passage. The matrix then passes into the mold cavity through the mold port.

[9] After injection is complete, the second piston seals the third flow passage while remnants of the matrix that remain in the second flow passage are driven into the first flow passage by the piston. The first piston is then driven toward the mold port. The orientation of the first piston and the second piston provides for the first piston to wipe matrix remnants from a face of the second piston. The seal between the first piston and mold port is now complete such that the molded article will cure within the cavity. The coupler is thus clear of remnants without flushing.

[10] The present invention therefore provides a valve assembly for a low-pressure mold which requires minimum flushing. Further, the present invention minimizes the necessity of flushing the mix head between transfer from one mold assembly to the next to decrease the cycle time for each finished article.

BRIEF DESCRIPTION OF THE DRAWINGS

[11] The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred

embodiment. The drawings that accompany the detailed description can be briefly described as follows:

[12] Figure 1 is a simplified schematic representation of a multiple material molding system having a valve assembly designed according to the present invention;

[13] Figure 2A is an expanded partial sectional view of a mix head assembly adjacent to a coupler mold assembly prior to engagement;

[14] Figure 2B is an expanded partial sectional view of the mix head assembly of Figure 2A locked into the a valve assembly;

[15] Figure 2C is a sectional view of a lock assembly taken along line 2C-2C of Figure 2B;

[16] Figure 3 is a sectional view of a piston taken along line 3-3 in Figure 2A;

[17] Figure 4 is another embodiment of a locking assembly according to the present invention;

[18] Figure 5A is a sectional view of the valve assembly in a first position which schematically illustrated a fluid material flow path;

[19] Figure 5B is a sectional view of the valve assembly in an intermediate position;

[20] Figure 5C is a sectional view of the valve assembly in a partially open position; and

[21] Figure 5D is a sectional view of the valve assembly in another partially open position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[22] Figure 1 schematically illustrates a multiple material molding system 10. The system 10 generally includes a plurality of fluid material supplies 12A, 12B and 12C, which communicate with a feed assembly 14 through respective supply conduits 16A-16C. The feed assembly 14 drives a desired quantity of fluid material from each fluid material supply 12A-12C through output conduits 18A-18C to a mix head assembly 20. The mix head assembly 20 thoroughly mixes the fluid material from each fluid material supply 12A-12C and injects the final mixture into a mold assembly 22 or the like. Preferably, a controller 23

communicates with the feed assembly 14 and the mix head assembly 20 to assure the system 10 is operating within predefined parameters. Controls for injection-molding equipment are known in the art and further description of the algorithms will not be further detailed herein. System 10 is preferably utilized for molding of very large parts, and in particular bath tubs and shower surrounds.

[23] Referring to Figure 2A, a partial sectional view of the mix head assembly 20 adjacent to the mold assembly 22 according to the present invention is illustrated. The mix head 20 mixes the multiple of fluid materials components e.g., matrix, to form a hardenable or settable mixture which is then discharged into the mold cavity 24 through a valve assembly 26. Typically, a single mix head 20 feeds the matrix into a multiple of mold assemblies which are arranged in an assembly line like environment. The matrix begins to set upon mixture and the valve assembly 26 according to the present invention minimizes matrix remnants such that the valve assembly 26 need not be flushed after each cycle injection.

[24] The valve assembly 26 preferably includes a coupler 28 to removably attach the mix head 20 to the mold assembly 22. The coupler 28 is attached to a mold port 30 such that the matrix from the mix head 20 communicates through a fluid flow passage 32 and to the mold cavity 24. The fluid flow passage 32 preferably includes a first flow passage 34 which defines a first axis 35 and a second flow passage 36 substantially perpendicular to the first axis 35.

[25] A piston 38 which is rectilinear in cross section (Figure 3) is movable within the first flow passage 34 along the first axis 35. An actuator 40 such as a pneumatic, mechanical, electrical or hydraulic actuator drives the piston 38 along the first axis 35 as illustrated by double headed arrow P. Preferably, the piston 38 is substantially square in cross-section (Figure 3) such that the piston 38 fits closely within the first flow passage 34. By providing the piston 38, with straight walls, remnants of the matrix are more effectively wiped from the passage 34 and driven into the mold cavity 24. In addition, the piston 38 forms an effective seal at the intersection between the first flow passage 34 and the second flow passage 36.

The first flow passage 34 preferably includes a liner 37 (Figure 3) of a low friction material such as Ultra High Molecular Weight Polyethylene (UHMEW), bronze, Teflon, or the like to assure minimal friction during movement of the piston 38.

[26] An end portion 40 of the piston 38 is preferably angled relative to the first axis 35. As illustrated in Figure 2B, the mix head 20 is engaged with the mold assembly 22 at an angle for operator convenience. The end portion 42 of the first flow passage is thus angled to coincide with the piston end portion 40 to assure an effective substantially conformal seal of the mold cavity 24 when the piston 38 is in a closed position (Figure 5C).

[27] The mix head 20 include a secondary portion of the second flow passage 36' which aligns with the second flow passage 36 within the coupler 28 when the mix head 20 is attached thereto (Figure 2B). The mix head 20 secondary, second flow passage 36' includes a second piston 44 which is movable along a second axis 45 as illustrated by double headed arrow S. The second piston 44 is preferably circular in cross section and is movable within a liner 46 as described above. The diameter of the second piston 44 is preferably less than the width of the wall of the first passage 34 to which the second flow passage 36 intersects.

[28] The second piston 44 is movable along the second axis 45 by a second actuator 48. Although a rotatable pinion gear 50 and rack 52 having corresponding gear teeth 54 are illustrated in the disclosed embodiment, other actuators such as a pneumatic, electrical or hydraulic actuators will also benefit from the present invention.

[29] A third fluid passage 56 communicates with the mix head 20 mix chamber (illustrated schematically at 58) and the secondary second flow passage 36'. Preferably, the third flow passage 56 runs substantially parallel to the second flow passage 36' from the mix chamber 58 then bends to intercept the second flow passage 36' in a substantially perpendicular relationship. Although other paths for the third flow passage will benefit from the present invention, a substantially perpendicular relationship assures that the second piston 44 will effectively seal the third flow passage 56 and shear remnants of the matrix into the first flow passage 34.

[30] A locking assembly 60 extends about the coupler 28 to engage and retain the mix head 20 to the mold assembly 22. The locking assembly 60 includes a multiple of movable lugs 62 which collapse around a nozzle 64 of the mix head 20 to engage receptors 66. In another embodiment, a threaded nut 68 (Figure 4) on coupler 28' engages a complimentary thread 70 on the nozzle 64'. It should be understood that other locking arrangements such as electromagnetic, linear, radial, and other locks will benefit from the present invention. Alternatively or additionally, the lock assembly manually and/or automatically activated such that the mix head is securely locked into the coupler during injection of the matrix while also providing rapid disengagement suitable for an assembly line-like environment.

[31] Figure 5A illustrates the matrix flow path (illustrated schematically by arrows m) during matrix injection into the mold cavity after the lock assembly 60 has securely locked the mix head 20 into the coupler 28. During matrix injection, matrix is pumped under pressure of the feed system 14 (Figure 1) from the mix chamber 58 (Figure 2B), through the third flow passage 56 and into the mix head 20 second flow passage 36'. The matrix continues into the coupler 28 second flow passage 36 and into the first flow passage 34. The matrix then passes into the mold cavity 24 through the mold port 30.

[32] After injection is complete, the second piston 44 is driven by the second actuator (illustrated schematically at 48 to seal the third flow passage 56 (Figure 5B). As illustrated in Figure 5B, the second piston extends from the mix head second flow passage 36' and into the coupler 28 second flow passage 36. In other words, the second piston 44 meets the first flow passage 39 in a substantially perpendicular orientation. Simultaneously remnants of the matrix which remain in the second flow passage 36', 36 are driven into the first flow passage 34 by the piston 44. Notably, the second piston 44 has been driven past the mix head second flow passage 36' and into the coupler flow passage 36. In other words, the second piston 44 assures that the second flow passage 36' is clear of matrix remnants.

[33] Referring to Figure 5C, piston 38 is now driven toward the mold port 30 by actuator 40 (illustrated schematically). Notably, the orientation of the first piston 38 and second piston

44 provides for the first piston 38 to wipe matrix remnants from a face of the second piston 44. The seal between piston 38 and mold port 30 is now complete and the molded article cures within the cavity 24. The coupler 28 is thus clear of remnants without flushing.

[34] Finally, the second piston 44 is retracted to its original position within the mix head 20 (Figure 5A). The lock assembly 60 is disengaged and the mix head 20 may be directed to another mold assembly where the process is repeated (Figure 2A). It should be understood that the second piston 44 can also be partially retracted such that the third flow passage 56 is sealed by the second piston 44 (Figure 5D) prior to full retraction (Figure 5A) to prevent inadvertent leakage of the matrix while the mix head is being transported from one mold assembly to the next.

[35] The foregoing description is exemplary rather than defined by the limitations within. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to determine the true scope and content of this invention.